Risk-based management of contaminated land in the UK: Lessons for China?

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\begin{abstract}
The management of contaminated land is now assuming greater attention in Chinese debates on environmental governance. However, the existing management system appears ineffective as it lacks a clear policy framework and technical basis. In the United Kingdom (UK), contaminated land issues are dealt with through a risk-based approach. This approach emphasizes the application of risk approaches in both technical and integrated management systems. Conceptually, this paper outlines generic issues related to transferring programmes from one place to another. We argue that too much emphasis has been placed on the barriers to effective transfer, rather than focusing on methods of abstracting lessons for application in foreign settings. We then examine the Chinese system and its problems in managing contaminated land before turning to the UK risk-based approach to see what lessons can be learned from it. Four aspects are analyzed and compared: legislative and policy framework; administrative structure and capacity; technical approaches; and incentive strategy. Based on the experience of the UK in practice, some suggestions are then proposed for China in order to improve its management of contaminated land. We suggest that this should include: a focus on the problem sites; development of a risk-based technical approach and integrated management system; the introduction of financial incentives; and the use of planning control as a management strategy. It is believed that a risk-based integrated management approach may be helpful for China to achieve sustainable solutions for contaminated land.
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\section{Introduction}

In recent years the issue of contaminated land has become a major concern in China. Water and air pollution have had greater attention and, as a result, the regulatory system for contaminated land remains largely undeveloped. This lack of attention has meant that the issue lacks a clear framework in terms of policy; administrative structure and capacity; technical methods; and incentive structures (Chen et al., 2004). However, the Chinese government’s 11th Five-Year-Plan draws attention to the hazards associated with contaminated land (Li, 2006a). New environmental laws and standards for soil quality are currently under development with contaminated land approaches see Meyer et al. (1995).

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In recent years the issue of contaminated land has become a major concern in China. Water and air pollution have had greater attention and, as a result, the regulatory system for contaminated land remains largely undeveloped. This lack of attention has meant that the issue lacks a clear framework in terms of policy; administrative structure and capacity; technical methods; and incentive structures (Chen et al., 2004). However, the Chinese government’s 11th Five-Year-Plan draws attention to the hazards associated with contaminated land (Li, 2006a). New environmental laws and standards for soil quality are currently under development with contaminated land approaches see Meyer et al. (1995).

We first examine the concept of policy transfer. The second section explores the land contamination problem in China, focusing in particular on the weak and fragmented system of regulation in place to deal with the problem. The UK policy framework and technical approaches that have developed over recent years are then analysed. The final section offers some suggestions for reforming the Chinese management system, based on lessons drawn from the UK. Overall, it is suggested that a more integrated management system, founded upon effective policy and risk-based technical approaches, may help China improve its regulatory
system for contaminated land. However, the paper cautions that there needs to be clear appreciation of the limits of the British system and the difficulties of transferring policies from one context to another.

2. Transferring regulatory policies

Within the literature describing policy choice and policy change, an increasingly important concept is that of policy transfer. Policy transfer, also called lesson learning (see Rose, 1991, 1993, 2005), explains the processes by which ‘knowledge about institutions, policies or delivery systems at one sector or level of governance is used in the development of institutions, policies or delivery systems at another sector or level of governance’ (Evans, 2006: 480). Rose (1993: 27) defined a lesson as ‘a detailed cause-and-effect description of a set of actions that government can consider in the light of experience elsewhere, including a prospective evaluation of whether what is done elsewhere could someday become effective here.’ A central concern is to explain the factors that encourage or discourage the transfer of programmes from one area or time to another. The lessons drawn may or may not lead to the transfer of policies or practices, depending on whether the lessons are deemed positive or negative (Bache and Taylor, 2003: 280). For Rose (2001: 2), the focus of analysis needs to be on ‘programmes’, defined as a combination of ‘laws and regulations, organization with officials to administer it, rules to guide the actions of officials and money to meet costs.’ Here, we are concerned with the particular programme dedicated to the management of contaminated land.

The motivations behind policy transfer vary. At one level, transfer is voluntary and based on a rational calculation that an existing policy needs to change because it has either been functioning at a lower standard than is deemed acceptable, or that it has lost political and/or professional support for other reasons such as that the programme operates in different social contexts. For example, introducing a risk-based approach into a risk-averse culture may produce substantial resistance to the new programme from implementers and the wider public. Rose (2001: 4) further distinguishes between contingent obstacles that are variable (e.g. economic priorities of the government of the day) or long-term (e.g. federal as against unitary institutions). More specifically, the incorporation of a lesson or a new programme will often be affected by the matrix of established programmes in any area. Such programmes will generally be interdependent, creating the problem that the ‘innovative value will depend on its being different from what went before, yet its success will depend on how well it integrates with other programmes to which it must relate in the same field’ (Rose, 2005: 107). As Evans (2006: 487) observed ‘... lesson-drawing can be a rational and progressive learning activity but only if the programme that is transferred is compatible with the value system of the recipient organization, culturally assimilated through comprehension evaluation and, in addition, builds on existing organizational strengths.’

To help overcome these contextual barriers, Rose (2001); (2005) advocates the development of models that abstract the generic elements of a programme that are necessary for it to be successfully exported. Abstraction provides a means of focusing on the essentials of a successful programme. It demands identifying the cause-and-effect relationships critical to making the programme succeed. Rose (2005: 72) identified a number of features that a model should recognize, including relevant laws and regulations; organizational structure and relevant types of personnel; how the programme is financed; and what the intended outputs and outcomes are. We identify these features in our case study of UK contaminated land policy later in the paper.

It is important to note here, however, how this paper differs from other studies. Evans (2006: 479) argued that there are two limitations to the existing literature on policy transfer/lesson drawing:

First, there is the relative absence of enterprising prescription to help public organizations solve public policy problems and, secondly, a stark failure to engage with practice, reflected in the reluctance to make social scientific enquiry relevant to practice. This has made it all too easy for practitioners to dismiss social scientific enquiry as ‘abstract’ and ‘impractical’ at a time when academics should be helping to set the public policy agenda.

Various studies of policy transfer and lesson drawing have been concerned with examining the reasons behind transfers, usually through analyzing (selective) historic case studies, and have not sought to utilize this approach in practice. Here we offer an evaluation of the UK approach to dealing with contaminated land, so that practical lessons may be offered for Chinese policy-makers.
This paper is thus concerned with lesson drawing, rather than co-er cive forms of policy transfer. The examination remains sensitive to tensions and difficulties within the UK approach and the particular Chinese context within which elements of the UK approach might be transferred. We note that the Chinese government has already incorporated key parts of the risk-based system upon which the UK approach is based. However, we suggest that these have not been embedded adequately into a more robust system of environmental governance. As a result, practice in dealing with contaminated sites remains highly variable across China. We argue that adopting key aspects of the UK system could provide a more effective means of regulating hazards arising from contaminated land.

3. Contaminated land management in China: status and problems

The issue of land contamination is becoming increasingly salient in Chinese debates on environmental governance. China’s rapid industrial growth and long-term agricultural activities have exacerbated the historical contamination of soil and groundwater. Chen’s (2002) anecdotal evidence indicates that around 36 million hectares of agricultural land have been contaminated by such organics as petrochemicals, pesticides, and polycyclic aromatic hydrocarbons. In addition, more than 20 million hectares of soils are potentially contaminated by heavy metals like cadmium and lead. Each year around 12 million tonnes of crops are found to contain heavy metal residues, causing direct economic losses of more than 20 billion RMB (US $2.5 billion) (Li, 2006a). The Chinese economy’s restructuring from a mainly ‘primary model’ of production (based on the exploitation of raw materials) to an increasingly industrial and service-based economy has presented new environmental challenges. This rapid industrialization has resulted in a growing number of abandoned mining sites and obsolete industrial complexes while also creating new polluting industrial enterprises, presenting an impending environmental threat. These sites are often located in or near densely populated areas, threatening human health via soil and groundwater. For example in one incident in 2006, 354 people including 146 children suffered lead poisoning in the northwest part of China from discharges from a nearby lead smelting plant (Xinhua News Agency, 2006). Furthermore, contamination can also reduce land values and inhibit viable re-use on both brownfield\(^2\) and previously undeveloped land.

The Chinese government has recognized the threat posed by contaminated land in its 11th Five-Year-Plan (Li, 2006b). A nationwide circular issued in 2004 by the State Environmental Protection Administration (SEPA) is another response, requiring polluting industries to monitor sites that potentially contain hazardous chemicals when their use changes (SEPA, 2004). In addition, the National Soil Pollution Survey Plan was launched in June 2006 by SEPA and the Ministry of Land and Resources (MLR) (Li, 2006a) to increase knowledge of the nature and extent of the problem in China. Furthermore, legislation and standards regarding contaminated land are currently being developed. Contaminated land is now gaining importance not just at the (political) decision-making level, but also at the implementation level by environmental professionals, such as remediation engineers and scientists.

As the management of contaminated land is a fairly new concern in China, the necessary expertise and experience is still underdeveloped. In addition to this, evidence suggests (Shen et al., 2004; Lee et al., 2006) that the existing system for managing contaminated land is not operating optimally. There exists:

1. A lack of a clear policy framework (such as overall policy objectives and principles) and an integrated legislative regime on contaminated land at a national level;
2. An extremely limited supply of experienced administrators and dedicated organizations responsible for contaminated land at both central and local levels;
3. Little technical expertise on management of contaminated land;
4. No financial incentives for cleanup and re-use of contaminated land.

These have become barriers to effectively managing contaminated land. Chinese policy-makers and related enforcement authorities could learn from the experiences of other countries. Through a process of lesson drawing, an exchange of information on the policies and practices of other nations could lead to a greater appreciation of the benefits brought by an integrated policy regime and scientific approach in achieving sustainable solutions for contaminated land.

3.1. Legislative and policy framework

At present China has no dedicated legislative regime for contaminated land. The legislative provisions that do exist are dispersed across existing legislation regarding water, air, agricultural land, forest and natural resources preservation (Table 1). Because there is no central policy regime, various issues associated with its management, such as regulatory principles and procedures, criteria for identification, risk assessment, remediation requirement, liability, and so on, are undeveloped (Lee et al., 2006). Therefore, existing legislative provisions cannot be viewed as an integrated regulatory system (Shen et al., 2004). This lack of integrated legislation is the major factor cited by administrative authorities,

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Legislation related to contaminated land in the UK and China</th>
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<tbody>
<tr>
<td>UK</td>
<td>China</td>
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<tr>
<td>1. Health and Safety at Work Act 1974</td>
<td>Related laws</td>
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<tr>
<td>2. Control of Pollution Act 1974</td>
<td>1. Environmental Protection Law 1989</td>
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<td>6. Control of Pollution Act 1989</td>
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<tr>
<td>7. Water Act 1989</td>
<td></td>
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<tr>
<td>8. Town and Country Planning Act 1990</td>
<td>Related standards</td>
</tr>
</tbody>
</table>

\(^2\) We adopt the definition of brownfield (also termed previously developed land) given by the UK in Annex C to Planning Policy Guidance 3 Housing (DETR, 2000a): ‘Previously-developed land is that which is or was occupied by a permanent structure (excluding agricultural or forestry buildings), and associated fixed surface infrastructure. The definition covers the curtilage of the development. Previously-developed land may occur in both built-up and rural settings. The definition includes defence buildings and land used for mineral extraction and waste disposal where provision for restoration has not been made through development control procedures.’ It is important to note here that virtually all current industrial land is contaminated, not just brownfields (Lerner and Tellam, 1992).
property developers, and land polluters for their failure to deal with contaminated land effectively.

Legislation that does exist in China mainly focuses on arable land for agricultural use, rather than land affected by industrial activities (Chen et al., 2004). This position has become increasingly untenable as China’s rapid industrial development and urban construction has resulted in a shift away from an economic model focused on agriculture and the extraction of mineral resources. This has resulted in a large number of abandoned steel production industrial complexes, antiquated chemical industries and mining sites located throughout the country. Such derelict sites are often located near cities, and could be re-used for other purposes. For example, the construction of the World Expo Park in Shanghai has entailed the demolition of more than 300 industrial works including dockyards, steel and power plants, releasing hundreds of hectares of contaminated land for redevelopment (Lee et al., 2006). Without an effective system setting out clear guidance and standards for regulating the remediation of such sites, human health is threatened. At the other extreme, sites may be over-remediated. At present, some enterprises in China, especially transnational corporations, use foreign guidance or standards when they choose to treat their own contaminated sites, producing unevenness in the application of standards for decontamination.

Like many countries across Europe and North America, the ‘polluter pays’ approach has been adopted in China. However, it has not been effectively implemented for land contamination as it is often difficult to find the original polluters of a site as they are often out of business long before the contamination hazard is unearthed. In addition, a substantial number of historic cases were caused by state-owned industries, meaning liability often falls with the government. We argue that it is necessary for China to develop a clear legislative framework to manage the redevelopment of these moribund industrial sites in a more integrated and systematic manner than currently exists.

3.2. Regulatory structure and capacity

Mirroring the fragmented legislative and policy framework, the organizational structure for regulation also lacks coherence. At a national level, responsibility for contaminated land is split across several different government departments and at a local level by their subordinate organizations. For example, agricultural organizations belong to the Ministry of Agriculture which has responsibility for managing contamination of arable land. Mining sites are managed by the governmental organizations under the Ministry of Land and Resources, and urban industrial sites are currently regulated by environmental organizations attached to the Ministry of Land and Resources. This has resulted in a large number of abandoned steel production industrial complexes, antiquated chemical industries and mining sites located throughout the country. Such derelict sites are often located near cities, and could be re-used for other purposes. For example, the construction of the World Expo Park in Shanghai has entailed the demolition of more than 300 industrial works including dockyards, steel and power plants, releasing hundreds of hectares of contaminated land for redevelopment (Lee et al., 2006). Without an effective system setting out clear guidance and standards for regulating the remediation of such sites, human health is threatened. At the other extreme, sites may be over-remediated. At present, some enterprises in China, especially transnational corporations, use foreign guidance or standards when they choose to treat their own contaminated sites, producing unevenness in the application of standards for decontamination.

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3.3. Technical approaches

Due to the lack of statutory guidance for the assessment of contaminated land, soil environmental impact assessment is not mandatory for development projects; neither is risk assessment a prerequisite for planning approval. Site investigation and assessment are thus not considered a priority for most developers.

The lack of statutory standards also hinders the effective management of contaminated sites, especially in urban areas. At present, there are two legislative standards (Table 1): Environmental Quality Standard for Soils 1995, and Environmental Quality Risk Assessment Criteria for Soil at Manufacturing Facilities 1999. The first is mandatory, but was designed mainly for agricultural land based on crop safety and is not suitable for other types of land use. The second was intended to assess the risks from industrial sites, but is not mandatory and fails to differentiate future land use. In addition, remediation guidance for contaminated land is not available, and this, together with the increased cost of decontamination, discourages many developers from taking remedial action.

3.4. Incentives for reusing contaminated land

Financial and legal incentives can be used as indirect tools for stimulating the remediation and sustainable redevelopment of polluted sites, as they are in the United States and the UK (see below). In the United States, many incentive schemes exist to help stimulate brownfield redevelopment. Incentives such as remediation grants, tax relief, loans, and legal indemnities are offered at federal level. Some states and local levels also offer incentives (see Bartsch and Wells, 2005). However, no such incentives exist in China. Because of this, developers are not encouraged to redevelop or remediate more heavily polluted sites. The low cost of using landfill makes it highly attractive for many developers to adopt the ‘dig and dump’ approach to remediation, and the overwhelming majority of land remediation in China is carried out this way (Lee et al., 2006). ‘Dig and dump’ is not considered sustainable as it merely transports the problem from one area to another, and increases the risk of harm through heavy civil engineering work and increased road traffic. More sustainable options such as biological remediation are not widely applied as financial support or legal

\(^1\) See Al-Tabbaa et al. (2007) for a detailed examination of the relative sustainability of different remediation technologies.
conditions to encourage them do not exist (Zhao et al., 2005). Utilization of these techniques has largely been an academic exercise with almost no application in commercial remediation engineering, except for a few cases carried out by foreign companies.

The system adopted in China to regulate contaminated land is clearly ad hoc and suffers from uneven practice. We now turn to examine the experience of the UK system.

4. Risk-based management of contaminated land: UK integrated approach

As the world’s first industrialized nation, Britain experienced rapid growth similar to that taking place in China today. Like China, however, this industrial base, while bringing prosperity, has also left a legacy of land contamination. Estimations of the extent of the problem in the UK vary. The Royal Commission on Environmental Pollution (1996: 20) suggested there might be between 50 000 and 200 000 hectares of contaminated land in the UK, while English Partnerships (2003), the body charged with overseeing policy for reclaiming and developing derelict land in England, argued that the figure is probably around 120 000 hectares. Although it is impossible to estimate precisely the cost of remediating this land, early projections suggested that it could range between £20 and £40 billion (Watson, 1993: 176). UK figures could increase if more contaminated sites were identified in the future, though it is suggested (Symns, 2002) that most cases have already been dealt with through the planning system in preparation for future development.

Since the creation of the current UK land use planning system in 1947, contaminated (non-agricultural) land has been dealt with primarily through the development planning process (Henneberry et al., 2005). Large scale remediation work on contaminated sites began in the 1960s, an early example being the restoration of the Lower Swansea Valley (Ferguson, 1999). The first central institutional mechanism to explicitly address this issue was established in 1976: the Inter-departmental Committee on the Redevelopment of Contaminated Land (ICRCL). By the end of the 1980s, however, various high-profile incidents and parliamentary reports forced government to concede the need for the issue to be addressed more comprehensively, and provision for registers of potentially contaminated sites was included in the Environmental Protection Act 1990. Heavy lobbying by the development industry, which feared property blight from such a potentially capacious definition, persuaded the government to drop the proposal before it could be implemented (Smith, 1999). After further consultation, the structure of the current system of regulation was created through the Environmental Act 1995, but the guidelines to local authorities on implementation were not promulgated until 2000.

The new approach is now being put in place, with local authorities surveying and registering sites which are known to be contaminated, particularly where there is no prospect of their redevelopment. Much of the content of the current policy regime on contaminated land reflects the long-standing practice of technical experts in the field. However, the system established by government sought to give this practice a legal basis while also creating a more integrated structure of policy which could ensure more even implementation of the principles and concepts throughout the country. In the next section we outline the main aspects of the system as it operates in the UK.

It is first necessary to provide some context to the wider policy ‘drivers’ of the current focus on developing brownfield and contaminated sites. The current emphasis has arisen in part because of the UK’s high population densities and increasing demands for housing provision, particularly in South East England. The perceived need to protect the rural heritage, thus creating more sustainable compact urban areas, is another factor. The current UK government has made changes to the principles underpinning the land use planning system with a greater emphasis on increasing brownfield development at the expense of greenfield sites. It has increased the targets for regional/local planning authorities to reach in respect to redeveloping brownfield land from 50% to 60%.

Alongside this approach, the government has identified areas of growth in areas such as the Thames Gateway and Milton Keynes where considerable brownfield and contaminated land exists alongside economic deprivation and housing shortages. In addition, it has given its main regeneration body, English Partnerships, a lead role in identifying and supporting development activities that will bring these sites back into productive use. It has also made the redevelopment of brownfield sites a key measurement of the success of the Regional Development Agencies (RDAs) that the government created in the late 1990s for English regions and the Greater London area. The redevelopment of brownfield land in areas like the Thames Gateway is at the heart of the current government’s agenda for tackling housing shortages in London and the South East, and creating ‘sustainable communities’. In February 2003, the UK government produced Sustainable Communities: Building for the Future which outlined the government’s plans for tackling housing shortages in the South East and low demand in northern England (Raco, 2005).

4.1. UK legislation and policy

In the UK, contaminated land is regulated by several different legislative regimes which interlock, including: (1) Part IIA of the Environment Act 1995 (hereafter ‘Part 2A’); (2) land use planning; (3) Integrated Pollution Prevention and Control; (4) waste management licensing; (5) Water Resource Act 1991 (Rudland et al., 2001). Statutory and non-statutory guidance supports these further, notably the DETR Circular (DETR, 2000b) and Planning Policy Guidance 23 (PPG23) (DoE, 1994a) and, more recently, by Planning Policy Statement 23 (PPS23) (ODPM, 2004). A wide variety of laws relevant to contaminated land are to be found within these different regimes (Table 1).

Part 2A and land use planning are the two principal policy processes forming the core of the regulatory system. Although Part 2A is the more visible process, more activity takes place under the land use planning process. Part 2A provides a proactive system for the control of contaminated land that poses an unacceptable risk to human health or the environment, based on the current use of the land (Henneberry et al., 2005). It is intended to do four things: improve the transparency and focus of regulatory controls; ensure that regulators take a strategic approach to land contamination problems; increase consistency in regulatory approaches; and provide a more tailored regulatory mechanism including liability rules able to reflect the complexity and range of circumstances found on individual sites (Lowe and Lowe, 2001; DETR, 2000b).

Prior to this, land contamination was managed either at a redevelopment stage or when contamination or a risk had become apparent.

The Part 2A regime sets out the UK’s policies on contaminated land which apply across the various pieces of legislation and regulation: (1) preventing the creation of new contamination; (2) promoting the remediation of the existing legacy of contamination through the redevelopment of land; and (3) intervening through a regulatory process to deal with existing contamination where redevelopment is not likely but a threat exists. These objectives are intended to support the UK government’s overall objectives of achieving sustainable development (DETR, 2000b; Lowe and Lowe, 2001).

The main thread running through the UK system is the emphasis placed on risk management. Part 2A introduced a risk-based statutory definition of ‘contaminated land’ so that land would only
be defined as ‘contaminated land’ where it appears that ‘by reason of substances in, on or under the land, that (1) Significant harm is being caused or there is a significant possibility of such harm being caused, or (2) Pollution of controlled waters is being, or is likely to be, caused’ (DETR, 2000b: Sec. 78A (2)). Contaminated land as defined in Part 2A is a subset of the wider legacy of land affected by contamination (EA, 2002). Only the sites which are causing or likely to cause unacceptable risks are considered problem sites suitable for a palliative response.

There are essentially six key features of the UK contaminated land system, which are discussed further below:

- It is primarily locally implemented, with the local authorities being the primary regulators;
- A risk-based decision-making approach is required to deal with the problem sites by using a source-pathway-receptor pollutant linkage concept and soil guideline values;
- A ‘suitable for use’ principle is adopted as the standard for remediation;
- Most contaminated sites are remediated as part of normal development process;
- Remediation and redevelopment of contaminated land can be supported where necessary through financial and legislative incentives;
- Liability is placed on original polluter and/or the current landowner/occupier (Catney et al., 2006; Lowe and Lowe, 2001).

However, the Part 2A system only deals with a small minority of polluted sites in the UK. The overwhelming majority are decontaminated through the land use planning system when they are developed or redeveloped. Land contamination is a ‘material consideration’ under the planning regime, and so planning authorities must consider the potential or actual presence of contamination before authorizing any particular changes to land use (Catney et al., 2006). If contamination is known or suspected, planning authorities can reject a planning application, restrict the proposed future use, or impose specific development conditions, for example, requiring a developer to investigate, assess, or if necessary, remediate the contamination (DoE, 1994b; Nathanail and Bardos, 2004). The role of the planning system is discussed in greater detail further below.

### 4.2. Regulatory structure and capacity

In the UK, the Environment Agency and local authorities are the statutory ‘managers’, who have clearly defined duties for dealing with contaminated land (see Table 2). The Environment Agency for England and Wales (EA) was created in 1996. Among its other duties, the EA is the UK government’s main advisory body for contaminated land policies, helping to develop a stronger scientific basis for dealing with the issue (Lowe and Lowe, 2001). It also provides guidelines and advice to local authorities and, in a small number of cases, intervenes directly to deal with an especially challenging category of sites known as ‘Special Sites’. In other parts of the UK, the Scottish Environment Protection Agency and the Environment and Heritage Service in Northern Ireland fulfil similar roles and functions as the Environment Agency.

As noted above, local authorities are the primary regulators of the Part 2A regime mainly because they generally possess considerable local knowledge about conditions and the nature of contaminated land within their boundaries (Catney et al., 2006). Their main work involves translating policy into practice. Part 2A requires local authorities to adopt and publish a formal written strategy for inspecting their areas for potentially contaminated sites. After the identification of any contaminated land ‘triggers’ (see below) their next duty is to secure remediation of the site in question. At this point, local authorities are required to establish liability for the land, and ensure remediation is carried out by this party so that it no longer poses a significant risk. Once a site is identified and assessed, they can serve a remediation notice on the ‘appropriate person’ (either the original polluter or the current site owner). National guidelines must be taken into account by the local authority when the amount and type of remediation work is specified (Bardos et al., 2002). However, it is important to note here that remediation notices are almost never used in practice. They are viewed as very prescriptive and difficult to write correctly (in accordance with legal standards), and are generally seen as a weapon of last resort when negotiations between regulators and ‘appropriate persons’ have failed.

The most significant driver of the regeneration of contaminated sites is the development process. When development proposals are brought forward on contaminated sites, local planning authorities may require remediation and other specific conditions, such as installation of infrastructure like new sewerage, before granting permission for development. The local authority may use Part 2A to instigate site investigations; oversee remediation strategies and check to ensure that the quality of remediation is acceptable, although the last of these is in practice rarely done. Where a site is contaminated but its current use does not pose an unacceptable risk (that is, it does not meet the Part 2A definition of contaminated land), then it will probably be dealt with under planning regime when the site is redeveloped (EA, 2002; ODPM, 2004; Catney et al., 2006). The interactions between the two policy processes are represented in Table 3.

### Table 2: Principal responsibilities under Part 2A

<table>
<thead>
<tr>
<th>Local authorities</th>
<th>Environment agency</th>
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<tbody>
<tr>
<td>Prepare and publish an inspection strategy</td>
<td>Provide relevant information held by the Agency to local authorities</td>
</tr>
<tr>
<td>Inspect their areas to identify contaminated land</td>
<td>Inspect potential special sites on behalf of the local authority</td>
</tr>
<tr>
<td>Consult the Agency on pollution of controlled waters</td>
<td>Ensure remediation of special sites</td>
</tr>
<tr>
<td>Ensure remediation of land identified as contaminated land</td>
<td>Maintain public register of regulatory action for special sites</td>
</tr>
<tr>
<td>Transfer special sites to the Agency</td>
<td>Prepare national reports on state of contaminated land</td>
</tr>
<tr>
<td>Maintain a public register of regulatory action</td>
<td>Provide advice to local authorities on identifying and dealing with pollution of controlled waters</td>
</tr>
<tr>
<td></td>
<td>Provide advice to local authorities on the remediation of contaminated land</td>
</tr>
</tbody>
</table>

4.3. UK incentives for re-use of contaminated land

The technical barriers to redevelopment of contaminated sites can be considerable, although rarely insurmountable given sufficient funding. A far greater barrier can be the economic, environmental and social context of a site. For example, sites in areas with high levels of stigma can deter volume house builders from focusing development on these areas (Dixon, 2006). Often the high rehabilitation costs of a site, weighed against low land values, may create an unacceptable level of risk for developers and investors, thus making development in these areas unattractive (Alberini et al., 2005). It is in cases like these that governmental support through financial incentives can help to stimulate development by reducing the overall potential risk of a project and providing benefits to the wider community. In the UK there are a variety of financial and legal incentives to encourage the re-use of contaminated sites (broadly, brownfield sites) (RESCUE Consortium, 2004), promoting to some extent the sustainable use of brownfield sites (including contaminated land) and decreasing demand for greenfield land.

Tax incentives include (Thornton and Nathanael, 2005; RESCUE Consortium, 2004):

- Landfill Tax Exemption Scheme;
- 150% corporation tax relief for contaminated land remediation costs;
- Capital allowances for apartments located over shops;
- Stamp duty exemption in deprived areas;
- VAT reductions on renovation costs of empty residential property

In addition, dereliction aid and gap funding schemes in the UK also support the re-use of derelict land. The Dereliction Aid Scheme (ODPM, 2002a) can fund up to 100% of the costs of remediating derelict land. Speculative and non-speculative gap funding schemes (ODPM, 2002b) enable local authorities to bridge the gap between development costs and likely end-value, allowing property developers to bring contaminated, derelict and disused sites back into full economic use. Grants of up to 50% of eligible costs are available, depending on location and the size of the developer.

Legal incentives and regulations also encourage development on brownfields (English Partnerships, 2003). Current space-related policies promote the idea of an ‘urban renaissance’ within the wider goal of achieving sustainable development. In addition, regional conditions are also taken into account. In areas where house prices are low and homes have been abandoned, there are programs of public and private investment; conversely, in areas where housing demand and house prices are high, there are programs to develop affordable housing for ‘key workers’ such as those in education, health, and community safety (Thornton and Nathanael, 2005).

This section has sought to outline the particular ways in which the UK policy system has developed to encourage ‘integration’. Part 2A and the planning system are the core policy processes charged with providing a coherent policy framework. Yet the degree to which this has been achieved has been questioned. Catney et al.’s (2006) analysis of the institutional structure for dealing with contaminated land in the UK suggested that the system is not as interlocking as is presented in government documentation. They argued that problematic misalignments in regulatory philosophies exist within the UK system on contaminated land. While the planning system is goal-seeking, relational and systems-based, holistic and participatory, the Part 2A process is problem-solving, project-focused, specific, technical and exclusive (Catney et al., 2006: 349). In addition, Part 2A is proactive, partly publicly funded and a process focused on dealing with contaminated sites for which there is no immediate prospect of development. The planning system, on the other hand, is reactive (to development proposals) and achieves privately funded treatment of contamination through the exercise of public regulation (Henneberry et al., 2005).

When compared with the Chinese system, however, the UK approach offers a comparably high degree of policy integration and technical sophistication. We now look at the technical basis on the UK system.

5. Risk-based management of contaminated land: UK technical approach

5.1. UK context of risk-based approach

A risk-based approach to managing contaminated land underpins national policy as well as the organizational policies of many contaminated landowners in the UK. This is claimed by government to provide a more robust, consistent and transparent basis for decision-making (Defra and EA, 2002a: para 3.8), and also that it effectively targets resources to the most important problems to give a good cost–benefit ratio. The risk approach pervades Part 2A – in the detailed text, the overall process, and the choices that are made in the system. It has been adopted for some years in the UK, and has recently been promoted at European level by CLARINET6 (Nathanail and Bardos, 2004).

Within the Part 2A regime, managing contaminated land involves identifying any unacceptable risks by using pollutant linkage concept and soil guideline values, then taking measures to reduce and control those risks to an acceptable level so that the land is “suitable for use”. These characteristics are analyzed in turn.

5.2. Source–pathway–receptor model

The source–pathway–receptor (pollutant linkage) concept is fundamental in defining what is treated as ‘contaminated land’

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6 CLARINET was a multi-national and interdisciplinary research network, supported by the European Union. Its primary objective was to develop technical recommendations for improving decision-making and remediation processes on contaminated sites in Europe. In particular, it was an important advocate for integrating risk assessment, remediation technologies and decision-making processes in a more systematic approach. CLARINET was arguably crucial in spreading many of the principles of the British system – particularly the risk-based approach – to other European nations.
under the UK system. ‘Source’ refers to the contaminant in the land which has the potential to cause harm or to cause pollution of controlled waters; the ‘pathway’ is the route or means (direct and indirect) in the environment by which the contaminant may be transferred to the receptors of concern; and the ‘receptor’ is the entity that may be adversely affected by the contaminant. There may be several potential receptors with different characteristics, such as aquatic ecosystems, human populations, or buildings, and correspondingly there will be multiple pathways to assess.

All three elements of the linkage must be present for a risk to exist, and risk assessment relies on identifying the likely presence and significance of a pollutant linkage. Thus, even where contaminants are present above a background concentration or a guideline value of acceptability, the site will not be considered to be ‘contaminated land’ if there are neither pathways nor receptors to be affected. This is a fundamental point. In a risk assessment, characterizing a pollutant linkage is crucial. For example, this can be done by delineating the source, modelling the fate and transport processes along the pathway, and the potential effect on, and behaviour of, the receptor. Hazardous sites may be controlled by breaking the pollutant linkages that present unacceptable risks, for example by reducing or modifying the source (e.g. by bio-remediation of contaminated soils); managing or breaking the pathway (e.g. by pump and treat or use of a cover system); or by modifying the receptor (e.g. by limiting land use).

Having established the presence, or likely presence, of these three elements, risk assessment is then required to identify which pollutant linkages are significant. This involves either a qualitative risk assessment based on an interpretation of a ‘conceptual model’ (an often diagrammatic characterization of the source-pathway-receptor linkage at a site), or a quantitative risk assessment at either generic or detailed level. Soil guideline values (see below), rather than standards, are particularly used as the criteria for the assessment of risks to human health (Defra and EA, 2002a). It needs to be stressed that a significant pollutant linkage must be present for a site to be determined as contaminated land. There may be more than one pollutant linkage on a piece of land, but it is likely that not every pollutant linkage identified from the conceptual model will be deemed significant (for more on specific risk methodology issues see Nathanail, 2005; Smith, 2006).

5.3. Soil guideline values

For the assessment of risk in the UK, soil guideline values (SGVs) are used for the pollutant linkage from soil to human health (excluding waterborne pathways). SGVs are generated by computerized risk models, such as the Environment Agency’s CLEA (Contaminated Land Exposure Assessment) model7 (see Nathanail, 2005; Smith, 2006). Generic SGVs are derived by employing the same procedures and algorithms used to generate site-specific assessment criteria, but applied to standard land use scenarios characterized by specific exposure assumptions. Derivation of site-specific SGVs is carried out where generic SGVs are not available or appropriate, or where particularly complex and/or sensitive site circumstances require it. Generic SGVs have been derived in the UK for a range of contaminants based on three typical land uses: residential (with and without plant uptake); allotments (these are householders’ small horticultural plots); and industrial/commercial. The SGVs do not just reflect the different classes of land use, but also, where appropriate, soil type, soil pH, soil organic matter, and so on. The government claims that the importance of these guideline values is to combine both authoritative science and policy judgments (Defra and EA, 2002a). In order to develop a firmer technical basis for SGVs, a series of CLEA research reports and procedural guidance have been published which advise how they should be used when dealing with contaminated sites (Defra and EA, 2002b).

SGVs represent ‘intervention values’, which indicate that soil concentrations above a certain level could pose unacceptable risks to the health of site users, and that further investigation and/or remediation is required (Defra and EA, 2002a). Moreover, SGVs can be used in connection with the formal requirements of Part 2A and the planning regime. These guideline values help local authorities decide whether land should be classed as contaminated on the grounds that there is a ‘significant possibility of significant harm’. In short, the use of guideline values allows flexibility and offers scope for professional judgment to be applied (Nathanail and Bardos, 2004).

Yet SGVs are more value laden than the government would suggest. It can be argued that SGVs reflect particular societal values, such as how cautious we are as a society, and what balance we seek to strike between protecting human health and ensuring continued development. In recent years a debate has focused on the level at which SGV thresholds have been set. The development industry argues that the current thresholds are set too low (with some SGVs being set close to or even below background levels), that the number of SGVs are too limited, and that local authority contaminated land officers treat SGVs as standards, rather than guidance, leading to unnecessary remediation of sites (Bell, 2006). These problems led the government in early 2004 to establish a Soil Guideline Task Force and in 2005 to place a moratorium on developing new SGVs while the taskforce deliberated. The result was Defra’s Soil Guideline Values: The Way Forward (Defra, 2006). This document set out over 20 main proposals for reforming the SGVs, but the main theme was that risk management must be proportionate, in particular to the ‘media and other risks’ (Defra, 2006: sec 5.28). It stressed that remediation should take place only where the risks posed by a site are ‘unacceptable’, rather than minimal, although Defra admitted that it was not clear what unacceptable constitutes:

What is less clear is what level of risk can be reached before it is regarded as unacceptable. There are no definitive answers here which can be immediately applied to land contamination. The issues will be different depending on the toxicology of the contaminant – in particular whether they exhibit threshold effects (for which there may be a so-called bright line test) or non-threshold effects (Defra, 2006: sec 5.35).

The moratorium on the development of further SGVs remains in place while further deliberation is undertaken on how guidance can be improved.

5.4. Suitable for use

Soil remediation is traditionally concerned with the restoration of ‘soil quality’. Remedial actions aim to reduce concentrations to levels below specific standards within the shortest possible time (Bardos et al., 2002). In such cases, the standards for remediation would be numerical target values set either at or below the triggering limit values for the contaminants. The permissible remediation approaches would be those that acted directly on the contaminants themselves. In contrast, the UK does not use generic statutory standards for acceptable concentrations of contaminants in soil. Part 2A builds remediation standards in a more flexible ‘suitable for use’ approach that reflects the wider concept of ‘managing’ the risk from contaminated land on a site by site basis. The ‘suitable for use’ approach focuses on the risks from land contamination, and recognizes that the risks presented by any given level of contamination will vary greatly according to the land

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7 The CLEA website can be accessed at: http://www.environment-agency.gov.uk/ subjects/landquality/113813/277113/35HQ/3D_e
The ‘suitable for use’ approach in the UK combines the requirement for ‘fitness for use’ with ‘protection of the environment’ (Vegter et al., 2002). It consists of two elements, the first ensuring that land is suitable for its current use – in other words, identifying land where contamination is causing unacceptable risks based on the current use and circumstances, and remediating the land to a condition where such risks no longer arise; this is the role of the Environment Agency in the case of ‘special sites’ and local authorities in the case of any other type of site. The second element ensures that land is made suitable for any future use, generally dealt with through the planning and building control regimes. In short, the ‘suitability for use’ concept offers a variable level of required remediation on a site so that unacceptable risks in relation to the current or future use of the land for which development permission is being sought. This can help reduce the costs of remediation as it limits the level of rehabilitation required according to the site’s immediate or proposed use. For example, a contaminated site proposed as a children’s playground will generally require a higher level of remediation than if it was proposed for a car park.

This approach is in contrast to the ‘multi-functional’ approach that was adopted in the Netherlands until recently, which stresses the need to rehabilitate sites to the highest possible standard, regardless of the potential costs. Honders et al. (2003: 2) stated that when the Dutch system was established in the early 1980s, it was estimated by the government that costs would be approximately 500 000 million euros. However, while the multi-functional approach largely eliminated the risks posed associated with the ‘suitable for use’ approach, it imposed a heavy burden on the Dutch exchequer. It is estimated that the total remediation costs have reached 50 billion euros (Honders et al., 2003: 2). By 1997, these costs eventually proved to be unacceptable and the Netherlands changed their system to incorporate a cost-effectiveness and risk-based assessment (CApERNET, 2003: 2).

The main overall benefit of the UK approach, from the UK government’s perspective, is that it reduces the financial burden on the public exchequer and on the development market (Catney et al., 2006). Implementation of the policy is greatly helped by the high land values which arise from the restrictions of use of greenfield sites and the resulting pressure to re-use brownfield; with high land values, the costs of remediation can usually be met within the redevelopment budget.

6. Discussion: lessons for China and prospects for successful transfer

As noted earlier, there is an increasing awareness in China that land quality is a crucial aspect of creating healthy and safe living conditions, vital aspects of sustainable development. This concern has led to the creation of new regulations relating to contaminated land, and, as a consequence, has increased demand for cost-effective approaches to environmental regulation. The UK approach, with its emphasis on balancing health and ecological protection with containing rehabilitation costs, has been presented so that lessons can be drawn for China.

Developing and implementing an effective regulatory system for contaminated land requires systematic integration of all aspects, including assessment; remediation; spatial planning; aftercare and monitoring; and so on. However, the existing management system for contaminated land in China seems ineffective because of its fragmented governance, legislative and policy framework, weak administrative organization and capacity, and limited technical knowledge. In the process of removing these hurdles, Chinese policy-makers have sought to learn from the experiences and approaches of other countries. This paper critically evaluates the aspects of the British system that could be incorporated into the Chinese approach. In particular, we suggest that the Chinese system needs to achieve greater integration in its policy and institutional design. In addition, we argue that the particular UK risk-based approach, with its core concepts of ‘source–pathway–receptor’, ‘soil guideline values’, and ‘suitability for use’, while not being entirely problem-free (see Catney et al., 2006), offer considerable potential for adaptation to the Chinese system.

Based on UK practice and experience, we make the following suggestions for China to improve the management of contaminated land:

1. A risk-based technical approach should be designed to prioritize problem sites for rehabilitation. The UK expertise in this field including the ‘pollutant linkage’ concept, the ‘soil guideline values’ approach, and the ‘suitable for use’ principle, can be a useful asset for China.

2. A risk-based integrated management system should be developed, containing clear policy, integrated legislation, professional administrators, technical approach and effective incentives for the problem sites.

3. Various economic and legal incentives can be introduced as indirect management instruments to encourage the remediation of contaminated land.

4. Planning control can be used as an important management strategy, both to impose conditions and to push up land values.

6.1. Developing risk-based integrated system for management of problem sites in China

The existing management system for contaminated land in China lacks integration due to its lack of clear policy, integrated legislation, professional administrators, and effective technical approach (Lee et al., 2006). The development of clear national policy (including policy objectives and principles) is a prerequisite for effective management of contaminated land.

One key element of the British approach is that it focuses on problem sites. In the context of Part 2A regime, only sites determined to be ‘contaminated sites’ by the ‘source–pathway–receptor’ models and which are causing, or likely to cause, unacceptable risks are dealt with through state action. At present, no system for prioritizing action on potentially hazardous sites exists in China. The definition of ‘contaminated land’ in China is opaque, and little guidance exists to indicate how officials should distinguish between polluted sites. Some contaminated sites have already been identified (Wang et al., 2005; Chen et al., 2004), but many others have not. The ongoing Nationwide Soil Pollution Survey may result in additional sites being identified (Li, 2006a).

As noted above, China’s ongoing rapid industrial development, agricultural modernization and urban construction means not only that contaminated sites are increasingly being discovered, but also that they will continually be generated into the future. It is therefore critical to prioritize those sites posing an imminent threat to human health and ecological systems. A risk-based approach is currently under development in China, but it lacks the sophistication of the UK approach with its application. The ‘pollutant linkage’ approach has come to represent the predominant intellectual framework for risk assessment and has underpinned the development of contaminated land technical thinking in recent years. ‘Guideline values’ and ‘suitable for use’ allow greater flexibility rather than national soil standards, and offers scope for professional judgment. These approaches should also, to a certain extent, be suitable for China.
6.2. Social-cultural risk differences as a barrier to policy transfer?

As stated earlier, historical and contextual barriers exist to the effective transfer of a programme from one country to another. While we have focused on the technical aspects of risk to this point, an important barrier to the successful transfer of UK practices is the difference in risk cultures between the UK and China.

Governmental environment agencies, such as the United States Environmental Protection Agency (EPA), tend to approach risk assessment as an objective exercise that operates in isolation to wider social dynamics (Andrews, 2006). However, social constructivist risk theorists challenge this simplistic assertion. What cuts across the various positions is that risk is never fully objective and value-free in the way that those subscribing to a ‘realist’ ontology often assert. Risk is thus not an unchanging object but is instead one that is continuously negotiated and reconstructed through social interactions (Lupton, 1999: 29–30). For example, as Andrews (2006: 219) notes: ‘Despite its widespread use … serious dispute remains regarding how much [of risk assessment] is merely a recasting of value judgments into scientific jargon.’ It is thus important to understand the socio-cultural context in which regulatory decisions are made, as this can have a role in shaping responses to particular risks.

While in the UK there has been some moves towards balancing environmental protection and economic development (see Catney et al., 2006), economic development in China has been more prominent in environmental decision-making (see Economy, Lieberthal, 4007). While China’s policy-makers at national level have allowed the creation of a number of different environmental protection programmes (largely through SEPA), these policies have encountered considerable resistance from subnational governments. They suggest that localities and regions are highly focused on driving up their GDP growth figures as these are key measure in annual performance evaluations (Economy and Lieberthal, 2007: 92). In addition, many local officials receive financial benefit from investing in key firms or by holding key positions in polluting enterprises (Economy and Lieberthal, 2007: 90), not to mention officials who accrue benefits in return for ignoring regulations. For all these reasons, local enforcement of environmental policies is low: in 2006, ‘SEPA announced that only 500 of the 70,000 violations of environmental regulations reported from 2003 through 2005 had been dealt with’ (Economy and Lieberthal, 2007: 90).

While there is a growing consciousness of environmental degradation and the hazards it poses, as shown by increasing environmental-related protests and the expansion of environmental NGOs (Ho, 2001; Yang, 2005), the perceived importance of economic growth is greater. In effect, Chinese local governments have entered into a ‘Faustian pact’ whereby they choose to accept environmental damage in exchange for economic expansion. Hence, the concept of risk is one that tends to be marginalized in Chinese environmental debates. Whilst local authorities in the UK have been encouraged by central government to engage with local communities in participatory forms of risk communication and risk management (though the actually practice is highly variable, see Catney et al., 2007), local governments in China do not seek, or welcome, broader public participation in regulatory decision-making in contaminated land management.

Overall, then, there are a number of potential barriers which can be identified to the successful transfer of the risk management aspects of the UK system. First, the fragmented structure of governance in China is a structural problem that is potentially difficult to resolve, though there is potential scope within the Chinese system for the centre to re-fashion the architecture of governance at subnational levels. What is potentially a more significant obstacle is the socio-cultural context of China. There is little appetite from local officials or the owners of polluting industries to see the introduction of a more rigorous system of land contamination regulation. The introduction of a risk-based regime as operates in the UK may have different outcomes in China, as local actors resist the policy because it does not align with their interests or culture.

6.3. Introducing incentives for remediation of problem sites in China

The remediation and re-use of contaminated land are frequently hindered by the economic, environmental and social barriers. Without state intervention, high rehabilitation costs, weighed against low land values, may create an unacceptable level of risk for developers and investors (Alberini et al., 2005). In the UK, a variety of economic and legal incentives are offered to encourage the cleanup and re-use of contaminated sites where there is little prospect of development. As indirect management instruments, these incentives promote the sustainable use of contaminated land and decrease the demand for greenfield in the UK.

There are at present no incentives available in China for contaminated land development. This, alongside low land values, discourages the remediation of contaminated sites. The low cost of landfill in China attracts developers to transfer, rather than re-mediate contamination by using the ‘dig and dump’ approach. Using a range of incentives such as those offered in the UK, in addition to increasing the cost of landfill as the European Union Landfill directive is doing in the UK (Price, 2001; Slater and Fredericksen, 2001), may help to reduce the use of ‘dig and dump’ in China.

6.4. Planning control: an important management strategy for contaminated land in China

Planning control plays an important role in management of contaminated land in the UK. Planning authorities are required to have to consider the potential or actual contamination before allowing any particular land re-use under the UK planning regime. Where there is contamination, planning permission can be refused, or specific conditions can be imposed on development. These may include site investigation, remediation strategy, and checks to ensure the remediation quality is acceptable. Where a site is contaminated but current use does not pose an unacceptable risk, it would not be dealt with until a proposal for redevelopment came forward; then it would be overseen by the planning regime. However, existing management systems in China attach little importance to the role of planning control in tackling contaminated land issues. Based on the UK experience, we argue that a system of planning control could be helpful for China to deal with problem sites during the redevelopment process.

7. Conclusion

The purpose of this article has been to utilize the policy-transfer/lesson drawing approach to explore which elements of the UK approach to regulating contaminated sites could usefully be applied in China. The existing system of regulation in China appears ineffective. It lacks a clear policy framework, administrative structure and capacity, solid scientific foundation, and effective financial incentives for the redevelopment of contaminated land. We suggest two key ways in which the UK system can be useful as a case from lesson drawing. The first is that it has developed a (relatively) integrated system of regulation (see Catney et al., 2006). The second is the risk-based technical approaches which are at the core of the UK system.

As stated earlier, one of the key challenges confronting agents of policy transfer is overcoming the contextual barriers that exist.
The UK and China differ markedly in many ways, including the respective political structures, ideologies, political, social and cultural values and historical development. These factors could have important consequences for the likelihood of successful transfer. For example, the UK system is based upon clear and well established laws on property rights, which have only recently been recognized in China. Ascribing liability on past polluters of sites may thus be even more problematic than it has been in the UK.

At another level, the introduction of the UK system of contaminated land management could have unintended consequences for the operation of the matrix of established programmes operating in China. As noted above, China has relatively well integrated systems of regulation for air and water pollution. The introduction of large elements of the UK approach would require it to operate along the grain of these regimes if it is not to disrupt their operation.

We have used the abstraction approach proposed by Rose (2001, 2005) in an attempt to overcome these contextual problems. Rose’s abstract model focuses on the generic elements of a programme that are necessary for it to be successfully. In this paper we have identified the relevant laws and regulations; the organizational structure and relevant types of personnel; how the programme is financed; and the intended programme outputs and outcomes of the British system for regulating contaminated land. Key parts of this system may thus be considered for adaptation and application in China. Overall we argue that emulation (Rose, 1993: 30) is the form of lesson drawing that needs to be taken, as some degree of adaptation is needed to account for contextual factors.

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